British Journal of Ophthalmology, 1987, 71, 405-414

Cataract: the relation between myopia and cataract morphology

NICHOLAS A P BROWN, AND ADRIAN R HILL

From the Nuffield Laboratory of Ophthalmology, University of Oxford, Walton Street, Oxford

SUMMARY The association between high myopia and cataract is already well established and an association between simple myopia and cataract has been suggested, but it has not been clear to what extent the myopia precedes the cataract or is the result of it. The present study compares the refraction of a group of 100 British patients at the time of first presentation with cataract in whom the refraction was also known four years previously, with a group of matched controls in whom the refraction was also known four years previous to presentation. The study shows that simple myopia does not appear to predispose to cataract. It is the development of the cataract itself, in particular nuclear sclerosis, which causes the refractive change towards myopia. The myopic change precedes the development of cataract, and patients over the age of 55 showing a myopic change in refraction have a very high probability of developing nuclear sclerotic cataract. The healthy aging eye and eyes with cortical cataract or subcapsular cataract, but without nuclear sclerosis, continue to show a gradual hypermetropic change with time.

The relationship of cataract to high (or degenerative) myopia is a well accepted concept.[1] It has also been considered that this relationship may extend to involve simple myopia and attention has been focused on this recently by Weale,[2] Perkins,[3] and Von Kluxen,[4] who each examined the refractive state of patients presenting at hospital with cataract and found an excess incidence of myopic refraction in them. Racz *et al*,[5] who examined patients with presenile cataract coming to surgery, found an excess incidence of myopia; the –19 to –21 dioptre group being well represented, which further confirms the association of cataract with the higher degrees of myopia.

Nuclear sclerotic cataract itself causes a change towards myopia, and so it is not possible to draw conclusions from these previous studies about the basic refractive states of the patients prior to the development of cataract. It is the object of the present study to make a contribution in this field.

Material and methods

It was decided to study a minimum of 100 patients presenting with cataract, in whom the refraction was known four years prior to the development of cataract, and to compare them with the same number of controls, matched for age, in whom the refraction was also known four years prior to the time of presentation. A period longer than four years would have been preferred but would have severely limited recruitment.

The patients with cataract and the controls were all patients attending a central London ophthalmic practice, with the expectation of a refractive examination and unaware of any eye disease. Only Caucasian subjects resident in England were accepted, in order to exclude the effects of differing environments. They could be admitted to the study if they had already attended four years previously. Patients were assigned to the cataract group when they had cataract visible by slit-lamp examination in the undilated pupil and at least minimal interference with visual acuity 6/7·5 or worse after refractive correction. It was decided to exclude high myopia and a limit was set at −12 D. Patients and controls were excluded if they had a recognised potential cause of cataract, including diabetes. Both the patients and controls were recruited strictly in order of their presentation without the exclusion of any cases that satisfied the above criteria. No attempt was made to match patients and controls for sex, but a

Correspondence to Nicholas Phelps Brown, 63 Harley Street, London W1N 1DD.

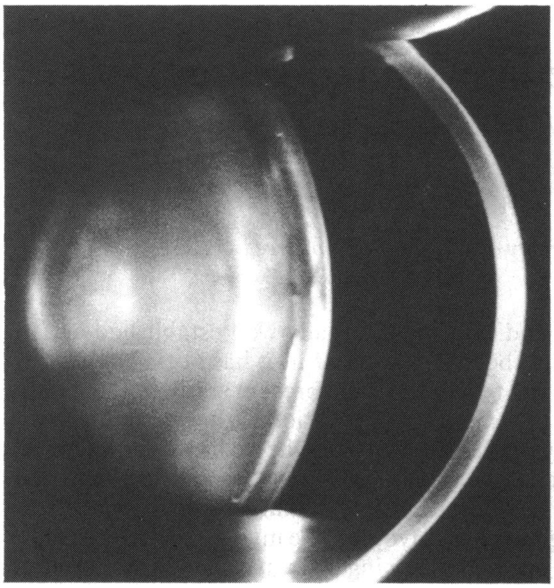

Fig. 1a

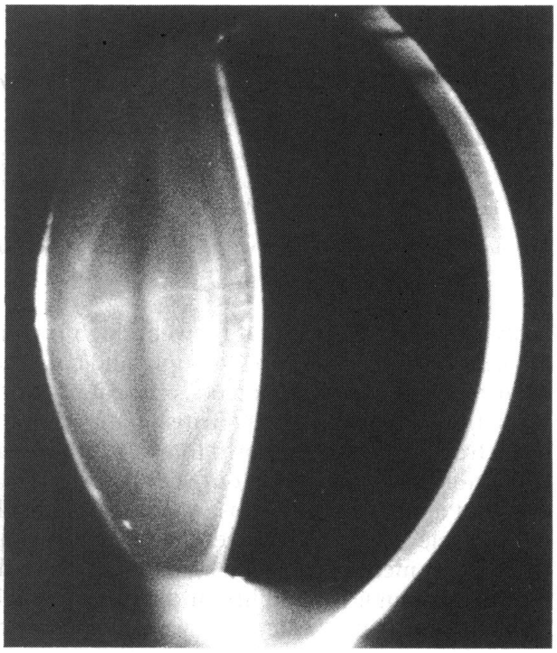

Fig. 1c

Fig. 1 *Slit-image photography of lenses with early cataract.* (a) *Cortical,* (b) *nuclear, and* (c) *subcapsular.*

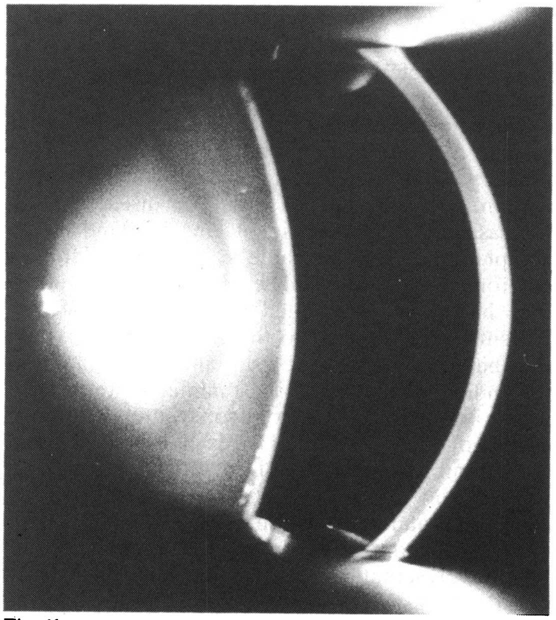

Fig. 1b

good match occurred spontaneously. The cataract group consisted of 110 patients, 71 female and 39 male, with 203 affected eyes. There were 110 controls (220 eyes), 74 female and 36 male.

The refractions were recorded, and to facilitate analysis they were simplified to spherical equivalent to the nearest 0·125 dioptres (ie., spherical component plus half cylindrical power in dioptres). By comparing the refraction at the time of presentation with cataract with the refraction four years previously the change in refraction could be determined. To simplify the tabulation of the results in respect of age the subjects were grouped into five-year age categories.

The cataracts were classified at the slit-lamp into cortical, nuclear, and subcapsular (Figs. 1a, b, and c). Although more than one cataract type may be present in an eye, it is possible to assess the refractive change associated with each cataract type separately or in combination by grouping the data as in Fig. 2. By this means it is possible to partition the data in a number of ways, either by using mutually exclusive categories or, for example, by comparing all cataracts having nuclear sclerosis against those without nuclear sclerosis.

Results

The age distributions of patients presenting with cataract and the matched control group are shown in Fig 3, from which it will be noted there is very close agreement. The most frequent age of presentation for both sample population was between 71-75 years. In patients older than this the prevalence of cataract

Grouping of cataract types for analysis

		Subcapsular Cataract	
		Present	Absent
Nuclear	Present	a	b
Cataract	Absent	c	d

a comprises (N + SC) and (N + SC + C)

b " (N) and (N + C)

c " (SC) and (SC + C)

d " (C alone)

where N = Nuclear sclerosis

SC = Subcapsular cataract

C = Cortical cataract

eg (N + SC) represents the simultaneous presence of nuclear sclerosis and subcapsular cataract

Fig. 2 *Contingency matrix for grouping the data according to the presence or absence of both nuclear and subcapsular cataract.*

was of course higher, but the incidence of presentation of new cases declined.

The incidence of the various types of cataract as a function of age is shown in Fig. 4. Among those eyes presenting with cataract cortical opacities were the most common, occurring in 63% of eyes, with nuclear cataract in 41% and subcapsular cataract in 24%.

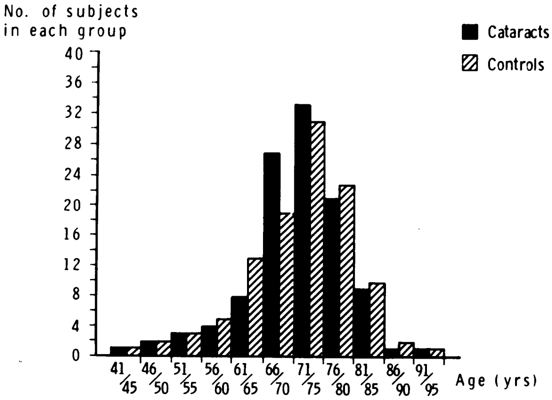

Fig. 3 *Age distribution of all cataract patients (n=110) and non cataractous controls (n=110).*

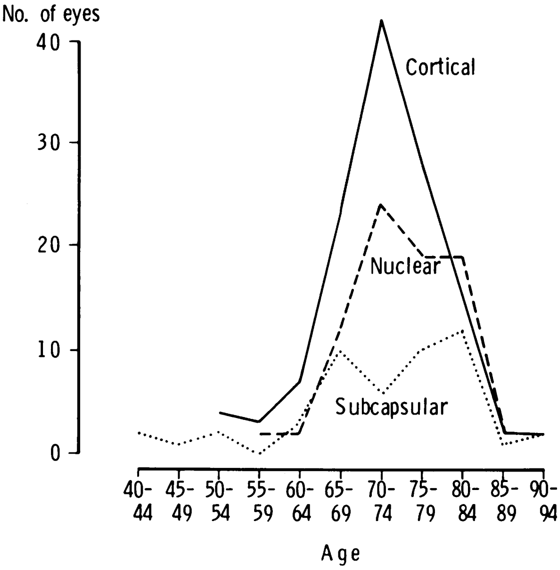

Fig. 4 *Incidence of the various types of cataract, as a function of refractive error (all eyes). In 55 of the 202 eyes presenting with cataract more than one morphological type of lens opacity was present (see Table 1).*

Slightly more than 70% of all eyes with cataract showed a single type of cataract. The frequencies of these mutually exclusive cataracts and their occurrence in combination are given in Table 1. The incidence of the different cataracts occurring singly or in combination is significantly different from chance, (χ^2 RE = 92·91, and χ^2 LE = 91·98, for df=6 have probabilities of occurrence of $p < 0{\cdot}0001$). A high correlation of cataract types occurring in the right and left eyes is also evident from Table 1, there being only a small number of uniocular cataracts. Such a high positive intereye correlation accords with clinical experience and is present in most ophthalmic data.[6 7] It precludes the combining of observations from right and left eyes for a single statistical analysis. Separate analysis have therefore been conducted on

Table 1 *Frequencies of the different cataract types presenting in isolation or in combination for right and left eyes*

Cataract combination	*Right*	*Left*
Cortical alone (C)	46	46
Nuclear alone (N)	19	16
Subcapsular alone (SC)	10	10
C with N	13	13
C with SC	3	4
N with SC	9	9
C with N with SC	2	2
Totals	102	100

These frequencies are from a total of 110 patients presenting with cataract, of which 18 were uniocular (10 right and 8 left).

Table 2 *Frequencies of the four major cataract groups as defined in Fig. 2*

	Right eye		*Left eye*	
	Subscapsular present	*Cataract absent*	*Subcapsular present*	*Cataract absent*
Nuclear present	11	32	11	29
Cataract present	13	46	14	46

single-eye data in a two-eye design, and only those results where the analyses gave consistent findings for right and left eyes are presented.

To test several hypotheses on the role of nuclear cataract and subcapsular cataract on refractive change over time the data were reorganised into four mutually exclusive cataract groups as defined in Fig. 2. This four-way grouping permits a comparison of the presence and absence of either nuclear cataract or subcapsular cataract or both. It will be appreciated from this grouping that the presence of cortical cataract is treated as a random variable, though since all the data treated in this way are from the eyes with cataracts those coded into cell D of the contingency table refer to the presence of cortical cataract alone. When organised in this way, the separate data for right and left eyes are as shown in Table 2. Analyses by χ^2 on the data for both right and left eyes show there was no difference in the presence or absence of nuclear cataract in the proportion of eyes presenting either with or without subcapsular cataract, (χ^2 RE = 0·033, χ^2 LE = 0·056, with df=1). At its time of initial occurrence, therefore, the presence of nuclear sclerosis was unrelated to the presence of subcapsular cataract.

The mean refractive error (spherical equivalent) for the four different cataract categories and the control group, both at presentation and four years prior to presentation, are shown in Table 3. The mean refraction of the controls at the initial examination was one of slight hypermetropia (R+0·90 D and L+0·72 D to the nearest 0·01 D), which accords closely with the most commonly occurring refractive error in the general population found by many other investigators.[8] The distributions of refractive errors for all cataract patients and controls both at the time of first cataract presentation and four years previously are shown in Figs. 5a, b, c, d. It will be seen that there was very close agreement between the two samples at four years prior to cataract presentation. Although the distribution of refractive errors departed slightly from normality (ie., a leptokurtosis with slight skewness towards myopia), this was not sufficient in the present samples to invalidate the use of parametric variance analyses.

However, the small sample size and related high variance of some of the cataract categories (notably C) precludes a useful analysis of the data as presented in Table 3. For example, the negative mean refraction of the subcapsular group (C) at both examination times is due almost entirely to the occurrence of one patient with bilateral high myopia as detailed in the footnote to Table 3. Nevertheless, all analyses presented in this paper include this myopic case,

Table 3 *Mean refraction (spherical equivalent in dioptres) among the different cataract categories**

Cataract Group‡		*(I) Four years preceding presentation*		*(II) At 'cataract' presentation*		*(III) Refractive change†*	
		RE	*LE*	*RE*	*LE*	*RE*	*LE*
A	x̄	0·975	1·102	−0·750	−0·523	−1·725	−1·625
	sd	2·071	1·904	2·391	2·404	0·914	1·169
B	x̄	0·277	0·405	−1·121	−0·832	−1·398	−1·237
	sd	2·690	2·760	2·977	2·938	1·086	0·841
C§	x̄	−1·886	−1·179	−1·705	−1·036	0·182	0·143
	sd	4·568	3·686	4·365	3·602	0·459	0·373
D	x̄	0·639	0·723	0·859	0·937	0·220	0·215
	sd	1·909	1·794	1·975	1·826	0·416	0·438
Controls	x̄	0·902	0·717	1·050	0·850	0·147	0·133
	sd	2·184	2·359	2·255	2·360	0·392	0·395

* For definition of cataract group see Fig 2.
† The computed mean values and standard deviations for 'refractive change' (ie., 'presentation' minus 'prior') are based on individual differences for all patients. Consequently, where the mean 'refractive change' does not exactly correspond with the difference between the means for 'presentation' and 'prior' refractive states this is a result of variance in the data.
‡ For details of the number of eyes in each group see Table 1, where x̄ = mean and SD = standard deviation.
§ If one high myopic case (R −11·625, L −11·00 at four years preceding cataract and R −11·00, R −10·625 at the presentation of cataract) is excluded from this group, the mean refractions and corresponding SD values for group C revise to: x̄: (I) R −0·739, L −0·423 (SD: 2·989, 2·409); (II) R −0·573, L −0·298 (SD 3·197, 2·462); (III) R +0·167, L +0·125 (SD 0·441, 0·382).

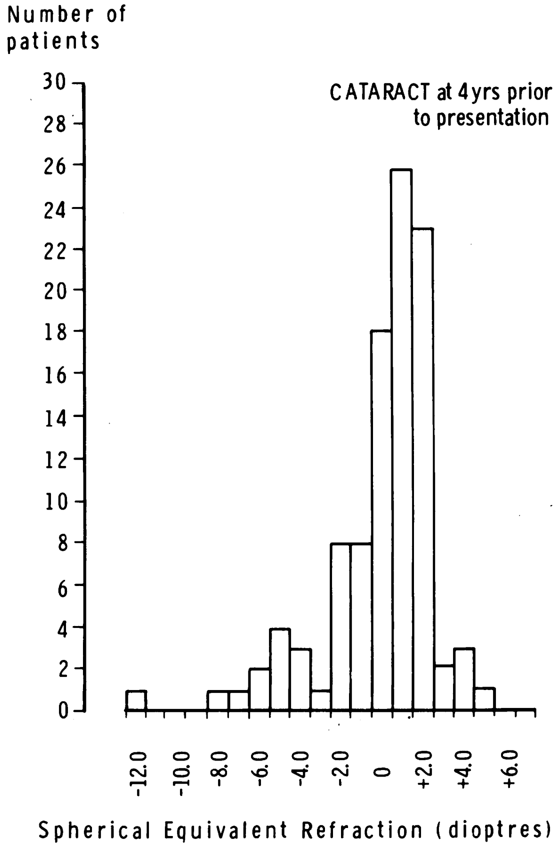

Fig. 5a

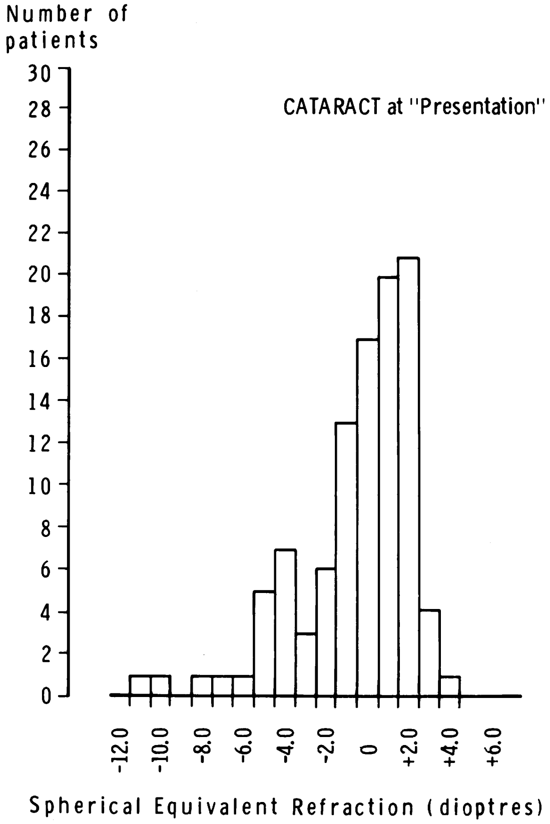

Fig. 5b

Fig. 5 *Distribution of refractive errors for 110 cataract patients* (a) *four years prior to the presentation of cataract and* (b) *at the time of initial cataract presentation; compared with the distribution of refractive errors for 110 age matched controls* (c) *four years prior to presentation and* (d) *at time of presentation for a refractive examination. Right eye data.**

since it did not exceed the exclusion criteria established at the outset of the study. Consequently, to test the hypothesis that nuclear cataract is associated with a myopic shift over time, the cataract data were regrouped into two categories at presentation comprising all those eyes possessing nuclear cataract versus all eyes without nuclear cataract. The mean refractions for these regrouped data are shown in Table 4. The analysis of variance for right eye data is summarised in Table 5. It shows a highly significant different change of refraction over four years in the nuclear compared with non nuclear cataract groups and controls. This interaction term is due to a relatively large mean myopic change in the presence of nuclear cataract (R −1·47 D, L −1·34 D), whereas there is a slight hypermetropic change both in the non-nuclear cataract group and in controls. A post-hoc Newman-Keuls test shows the change in refraction over four years in each of the three groups (i.e., nuclear cataract, non-nuclear cataract, and control) to be highly significant, as also were the differences in mean refraction between cataract categories and controls at each examination time ($p<0{\cdot}01$). (The differences between mean refractions at four years prior to cataract presentation become insignificant if the single case of high myopia is removed. For details of this case see footnote to Table 3.) The distribution of the change in refractive error over time for the nuclear and non-nuclear cataract groups is shown in Figs. 6 a, b.

To test the hypothesis that the myopic shift occurring in nuclear cataract is independent of the initial ametropic state the data were structured for further analysis according to whether an eye was myopic or hypermetropic at four years prior to cataract presentation. Separate analyses of variance on right and left eye data were conducted on the *change* in refractive error occurring over the four-year interval between examinations. A summary of the variance analysis for right eye data is given in Table 6, from which it

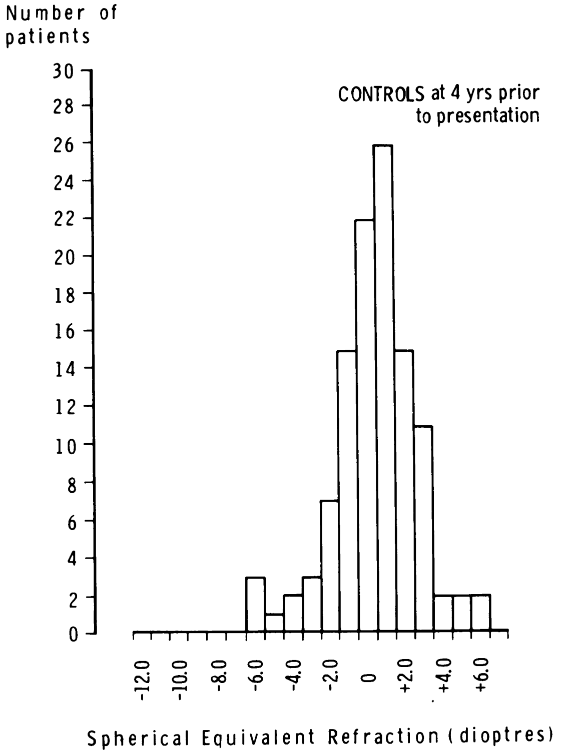

Fig. 5c

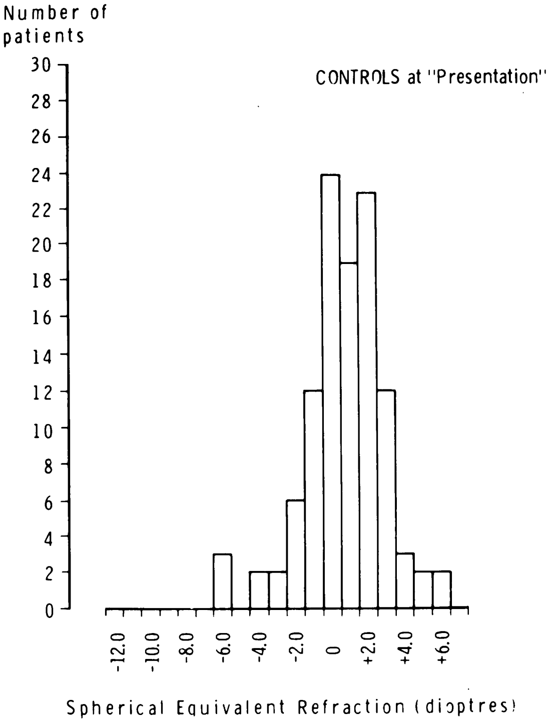

Fig. 5d

will be seen that there was neither a significant interaction of refractive change between ametropia and cataract type, nor was there a significant main effect due to ametropic state. This implies that the mean refraction for the sample of myopes and the sample of hypermetropes did not differ between the cataract group and the controls. The data were examined further to determine whether there was a greater proportion of myopes than of non-myopes in the cataract group at four years prior to presentation. Table 7 shows there was no difference between the cataract group and controls in the proportion of myopes to non-myopes. A χ^2 test gives the probability associated with these proportions being the same in each group as p>0·8, (χ^2 RE=0·028, and χ^2 LE=0·058, each with df=1). The myopic shift observed in nuclear cataract was therefore independent of whether an eye started out as being refractively myopic or hypermetropic.

Analyses of variance conducted on the data when

Table 4 *Mean refraction error (spherical equivalent in dioptres) for eyes with and without nuclear cataract*

		(I) Four years preceding presentation		*(II) At 'cataract' presentation*		*(III) Refractive change† (II – I)*	
*Cataract Group**		*RE*	*LE*	*RE*	*LE*	*RE*	*LE*
(A+B)	x̄	0·439	0·597	–1·035	–0·747	–1·474	–1·344
nuclear	sd	2·554	2·549	2·828	2·775	1·048	0·943
cataract							
(C+D) non–	x̄	0·168	0·279	0·381	0·477	0·213	0·198
nuclear	sd	2·745	2·471	2·731	2·472	0·421	0·422
cataract							
Controls	x̄	0·902	0·717	1·050	0·850	0·147	0·133
	sd	2·184	2·359	2·255	2·360	0·392	0·395

* and † see footnotes to Table 3.

Table 5 *Summary analysis of variance of refractive error as a function of examination time (presentation versus four years prior) and cataract group (nuclear versus non-nuclear versus controls). Right eye data**

Source of variation	*SS*	*DF*	*F*	*p*
Cataract group (C)	110·36	2	4·58	0·0113
Error	2517·08	209		
Examination time (T)	12·57	1	71·85	<0·0001
C × T	46·41	2	132·60	<0·0001
Error	36·58	209		

* Anova for left eye shows similar results with a comparable distribution of variances.

Table 6 *Summary analysis of variance of four-year change in refraction as a function of initial ametropic state (myopia versus hypermetropia) and cataract group (nuclear versus non-nuclear versus controls). Right eye data**

Source of variation	*SS*	*DF*	*F*	*p*
Ametropia (A)	0·1691	1	0·49	0·4845
Cataract group (C)	87·2405	2	126·53	<0·0001
A × C	1·4768	2	2·14	0·1201
Error	71·0185	206		

* Anova for left eye shows similar results with a comparable distribution of variances.

grouped according to the patients' sex showed there to be no difference in the refractive change in the nuclear and non-nuclear cataract groups for males compared with females.

Discussion

The application of the findings of this study, may be limited by the restrictive nature of the sampling, which has been confined to a group of Caucasian British patients attending a central London practice. However, this is a good place in which to make a study of the relationship of simple myopia to cataract since environmental factors in the causation of cataract are minimal.

The finding of an excess incidence of cataract in the female is similar to that found by Perkins.[3] It is interesting that the same ratio of female to male occurs in the controls. Although the study deals with age groups in which females predominate, since the sex ratio is the same in the cataract group and in the controls it cannot be stated that the female is more prone to cataract.

The present study differs from previous studies in that the refractive state of eyes were obtained at the time of *first* presentation with cataract and compared with the refractive state of these same eyes before the

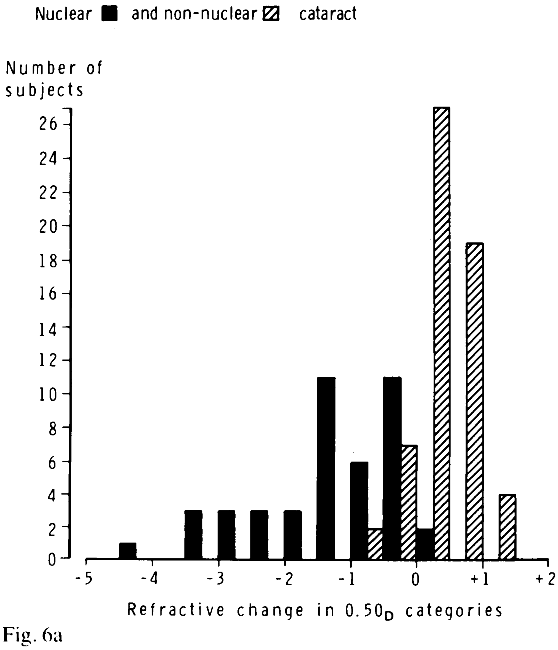

Fig. 6a

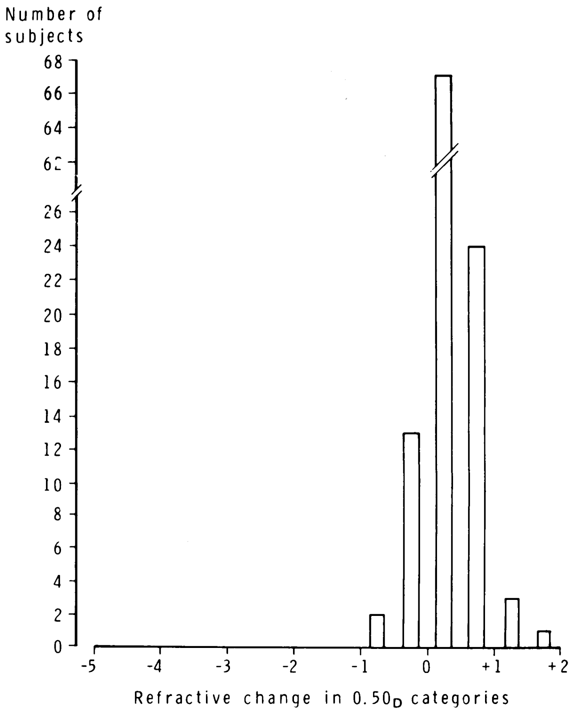

Fig. 6b

Fig. 6 *Refractive change over four years of eyes with* (a) *nuclear cataract and non-nuclear cataract and* (b) *controls (right eye data).*

Table 7 *Frequency of patients having myopia and those without myopia (ie., emmetropia and hypermetropia) at four years prior to presentation, for the cataract group and the controls. Right eye data*

	Right eye		*Left eye*	
	Cataract group	*Controls*	*Cataract group*	*Controls*
Myopes	29	30	26	27
Non-myopes	73	80	74	83
Ratio myopes/ non-myopes	0·397	0·375	0·351	0·325

development of cataract. The cataracts were seen at the time of their first presentation. They can therefore be presumed to be earlier in their natural history than would be the case in those patients being examined at hospital after referral with cataract, as have been considered in other studies.

A tendency to myopia was confirmed at the time of diagnosis of cataract, which corroborates the work of Weale,[2] Perkins,[3] Von Kluxen.[4] In particular, it is shown that a marked myopic shift (Fig. 5) had occurred in the four years preceding the presentation of cataract only in those eyes with nuclear cataract. Furthermore, there is no evidence in the data that the myopic shift is any different among eyes which were myopic or hypermetropic before the presentation with cataract. From these results it is possible to speculate that the increased prevalence of myopia among eyes with cataract is entirely due to the cataract and did not precede it. This is further substantiated by the extremely close agreement of mean refractive error between the cataract group and controls at the four-year stage preceding cataract presentation.

When the mean refractions for both ophthalmic examinations for the cataracts and the controls are plotted graphically (Fig. 7), it can be seen that they represent two diverging groups of individuals.

By the application of Darwinian theory[9] it can be suggested that each group has evolved from one common group of individuals, which is shown in the graph by the extrapolated dotted line. It is reasonable to conclude, therefore, that simple myopia does not predispose to cataract, but is the product of cataracts which include the element of nuclear sclerosis.

There is also a suggestion in the data that the combination of nuclear and subcapsular cataract (group A) produces the largest refractive change, (R −1·725 D, L −1·625 D in four years; Table 4). Although this is not significantly different from the effects of nuclear cataract alone, it has been noted previously[10] that lenses with nuclear sclerosis and subcapsular cataract are liable to have a thinned cortex, with reduced radius of curvature of the anterior surface, so that a greater change in this group may be explained by the combination of refractive index change (nuclear) and curvature change (cortical).

The relation of hypermetropia to cataract has been considered by Bourdon-Cooper,[11] who observed that cataract was more common in ametropia, especially in hypermetropia. The contrary was reported by Von Kluxen,[4] who found cataract to be common in myopia and emmetropia but rare in hypermetropia. In the present study, which used a random sampling procedure for the inclusion of all eligible patients at the time of first presentation with cataract, there was no evidence from the refractions of four years previously (when cataract was not present) that myopia or hypermetropia were more prevalent than among a sample of age matched non cataractous controls. Hence, excluding the special condition of the degenerative myopias in excess of −10·00 D, a

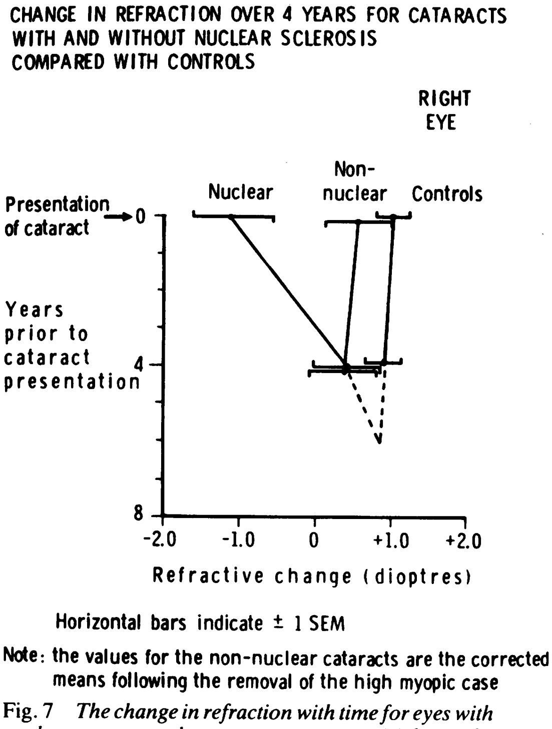

Fig. 7 *The change in refraction with time for eyes with nuclear cataract and non-cataractous eyes (right eye data). The broken line is extrapolated to a proposed common mean refractive status prior to the onset of cataractous changes, which, it is suggested, occur at about six years before the clinical appearance of a cataract by slit-lamp examination. The horizontal bars indicate ±1 standard error of the mean. The mean values for the non-nuclear cataracts exclude the case of high myopia (see footnote to Table 4).*

refractively myopic eye is at no greater risk of developing cataract than one with hypermetropia.

It has been suggested that stress induced in the lens fibres by the change in the shape of the lens on accommodation is a cause of cataract. Bourden-Cooper[11] suggested that the greater need to accommodate by the hypermetropic eye might be causative. The theory of accommodative cause can alternatively be applied to account for a greater incidence of cataract in myopia. Weale[2] quoted Fisher's work[12 13] on lens fibre stress to show that the latently accommodated lens of the hypermetrope would be relaxed, whereas in the myopic eye the lens would be stressed by a continually unrelaxed zonule.

The refractive change through life was studied in detail by Slataper, who showed that a hypermetropic change was normal up to the age of 64, after which refraction levelled out and then changed in the direction of myopia. His series of subjects did not exclude those developing cataract. Since cataract becomes very prevalent after the age of 60,[15-18] Slataper's subjects would have included a high proportion of cataract patients in the older age groups. Indeed Slataper himself considered that the myopic change which he recorded in old age was due to cataract, a deduction which is confirmed by the present study. When cases with cataract are excluded, it is seen that a continuing hypermetropic refractive change is found in the healthy eye in old age (Table 3 and Fig. 5). The finding of a myopic refractive change in a seemingly healthy eye in a middle aged or older person should therefore be considered as an indication of impending cataract.

The incidence of the different types of cataract – cortical, nuclear, and subcapsular (Table 1 and Fig. 4) – appears similar to that observed by Foster and Benson[19] in patients presenting with reduced visual acuity due to cataract at a hospital in Leeds. Direct comparisons cannot be made because they classified mixed types of opacities separately and did not relate the incidence to age. In the present study it is noteworthy that subcapsular cataract is the first to appear, presenting in the 40–44 year age group, since it is in the younger age groups that the ophthalmologist is most often asked to determine whether a cataract is spontaneous or due to exposure to drugs, irradiation, or other cause. Thus the identification of a cataract as subcapsular is not in itself evidence of a probable external cause. Perkins[3] recorded a higher incidence of subcapsular cataract at 40% compared with 24% in the present study. The difference can be accounted for by his patients having more advanced cataract than those in the present study. A patient presenting with cortical or nuclear cataract will often develop subcapsular cataract later, which will bring them to hospital because of its more disabling effect on visual acuity. The reported incidence of subcapsular cataract is still lower in other series: 6% in Foster and Benson's series,[19] 10% in Kirby's series,[20] and only 1·8% in Chatterjee's series.[21]

Conclusion

This study shows that simple myopia does not appear to predispose to cataract. It is the development of the cataract itself, in particular nuclear sclerosis, which causes the refractive change towards myopia. The myopic change precedes the development of recognisable cataract, and it can be shown by using Bayesian statistics[22] that the probability of a person over the age of 55 having nuclear sclerosis, given a refractive change of at least −1·00 D over four years, is 0·99. The healthy aging eye continues to show a gradual hypermetropic change.

We are grateful to Dr B C Reeves for computing assistance.

References

1 Duke-Elder S. *System of ophthalmology*. London: Kimpton, 1970; **11:** 225.
2 Weale R. A note on a possible relation between refraction and a disposition for senile nuclear cataract. *Br J Ophthalmol* 1980; **64:** 311-4.
3 Perkins ES. Cataract: refractive error, diabetes, and morphology. *Br J Ophthalmol* 1984; **68:** 293-7.
4 Von Kluxen G. Klinische und experimentelle Untersuchungen an Alterskatarakten. *Fortschr Med* 1985; **103:** 243-6.
5 Racz P, Koszoras L, Ordogh M. Investigations on bilateral presenile cataracts. *Lens Res* 1984; **2:** 13-21.
6 Rosner B. Statistical methods in ophthalmology: an adjustment for the intraclass correlation between eyes. *Biometrics* 1982; **38:** 105.
7 Ray WA, O'Day DM. Statistical analysis of multi-eye data in ophthalmic research. *Invest Ophthalmol Vis Sci* 1985; **26:** 1186-8.
8 Duke-Elder S. *System of ophthalmology*. London: Kimpton, 1970; **5:** 234.
9 Darwin C. *The origin of species by means of natural selection*. London: Murray, 1859.
10 Brown N, Tripathi R. Loss of the anterior subcapsular clear zone of the lens. Prognostic significance in cataract formation. *Trans Ophthalmol Soc UK* 1974; **94:** 29-45.
11 Bourdon-Cooper J. Aetiology of cataract. *Br J Ophthalmol* 1922; **6:** 385-412.
12 Fisher RF. Senile cataract: a comparative study between lens fibres stress and cuneiform opacity formation. *Trans Ophthalmol Soc UK* 1970; **90:** 93-109.
13 Fisher RF. In: *The human lens in relation to cataract*. Ciba Foundation symposium No. 19. Amsterdam: Associated Scientific Publishers, 1973: 307-8.
14 Slataper FJ. Age norms of refraction and vision. *Arch Ophthalmol* 1950; **43:** 466-81.
15 Gradle H. Study of lenticular change with age. *Ophthalmic Sci* 1926; **62:** 255.
16 Fisher FP. Ueber Altersveranderungen des Auges. *Ophthalmologica* 1941; **102:** 226-32.
17 Shafer RN, Rosenthal G. Comparison of cataract incidence in normal and glaucomatous populations. *Am J Ophthalmol* 1970; **69:** 368-70.
18 Gibson JM, Rosenthal AR, Lavery J. A study of the prevalence

of eye disease in the elderly in an English community. *Trans Ophthalmol Soc UK* 1985; **104:** 196-203.
19 Foster J, Benson J. The percentage incidence and surgical significance of the different forms of senile cataract. *Trans Ophthalmol Soc UK* 1934; **54:** 127-36.
20 Kirby DB. Pathogenesis of senile cataract. *Arch Ophthalmol* 1932; **8:** 96-119.
21 Chatterjee A, Milton RC, Thyle S. Prevalence and aetiology of cataract in Punjab. *Br J Ophthalmol* 1982; **66:** 35-42.
22 Aspinall PA, Hill AR. Clinical inferences and decisions – I. Diagnosis and Bayes' theorem. *Ophthalmic Physiol Opt* 1983; **3:** 295-304.

Accepted for publication 25 June 1986